

# **The Killearn Chain of Lakes**

## **An Investigation of the Lake Arrowhead Drainage to Lake Iamonia**

By  
Sean E. McGlynn, Ph.D.  
McGlynn Laboratories Inc.

**Draft**

**Wednesday, June 23, 2004**

**Funded by:  
The Leon County Board of County Commissioners**

## Table of Contents

Part 1: Trophic State Indices

Part 2: Lake Arrowhead Drainage

Appendix 1: FDoH Microbiological Guidelines

Appendix 2: TSI Formula

Appendix 3: Flow data

Appendix 4: Water Quality Data

Appendix 5: Bibliography

## Introduction

# The Killearn Chain of Lakes

This report is divided into two parts. Part 1 is a background chapter on water quality issues within the Killearn Chain of Lakes, the 'Trophic State Indices (TSI)'. Part 2, details the preliminary results of an investigation of the 'Lake Arrowhead Drainage' regarding bacteria and nutrient levels following wet periods. The Lakes within the Killearn Chain of Lakes drain into Lake Iamonia from at least two directions. Lake Arrowhead and Lake Monkey Business both feed into different parts of Lake Iamonia. Lake Monkey Business drains into Lester Cove and Lake Arrowhead flows into Lake Iamonia at the Cromarty Arm.

Lake Iamonia Outlet is a medium priority TMDL set for 2007. The Killearn Chain of Lakes drains into this impaired waterbody. The various Lakes within the Killearn Chain of Lakes were listed on the planning list as being impaired due to high Trophic State Indices (TSI), low Dissolved Oxygen (DO), high Turbidity, as well as high Fecal and Total Coliform bacteria. The lakes within the Killearn Chain of Lakes were dropped from the TMDL list because of a lack of data. Lake Monkey Business was shown to be a source of nutrient enrichment to Lake Iamonia in previous studies (McGlynn, 1997 and McGlynn 1999). In addition to these studies, 10 years of data were collected on each of these lakes by the University of Florida's Lakewatch program show that water quality within these lakes is not satisfactory. There is no lack of data on these waterbodies.

The water quality within the Killearn Chain of Lakes is quite poor and has been in this state for some time. The Lakes with the worst water quality are the two that discharge into Lake Iamonia. It has been shown in previous studies that the discharge from Lake Monkey Business into Lake Iamonia contributes to the nutrient enrichment of Lake Iamonia, an 'Outstanding Florida Waterbody' (OFW) that is on the FDEP's verified list and is scheduled for a TMDL in 2007. An investigation of the other drainage, the run from Lake Arrowhead into Lake Iamonia is presented here. This drainage had not been

previously investigated. Several flows from the Killearn Lakes Subdivision join this drainage after it leaves Lake Arrowhead, which is the second worst Lake, in terms of water quality, in the Killearn Chain of Lakes. Multiple sampling stations were investigated in this study. Bacteria chlorides and nutrients were found at levels in the Lake Arrowhead drainage that are a cause for concern, both regarding nutrient loading to Lake Iamonia and human health. Elevated levels of Enterococcus bacteria indicate a human origin of the bacteria. Water from malfunctioning septic tanks may be contributing to the degraded water quality of this drainage.

## **Part 2**

# **The Killearn Chain of Lakes**

## **Lake Arrowhead Drainage**

This study focused on the Drainage from Lake Arrowhead into Lake Iamonia through the Cromarty Arm (Figure 1). This drainage has not been previously investigated. Several drainages from the Killearn Lakes Subdivision join this drainage after it leaves Lake Arrowhead, the second worst Lake, in terms of water quality, in the Killearn Chain of Lakes. Figure 2 depicts the various sampling stations investigated in this study. Water from malfunctioning septic tanks may be contributing to the degraded water quality of this drainage.



Figure 1: The study area is depicted within the circle on this map of the Killearn Lakes area. This represents the drainage from Lake Arrowhead into Lake Iamonia.

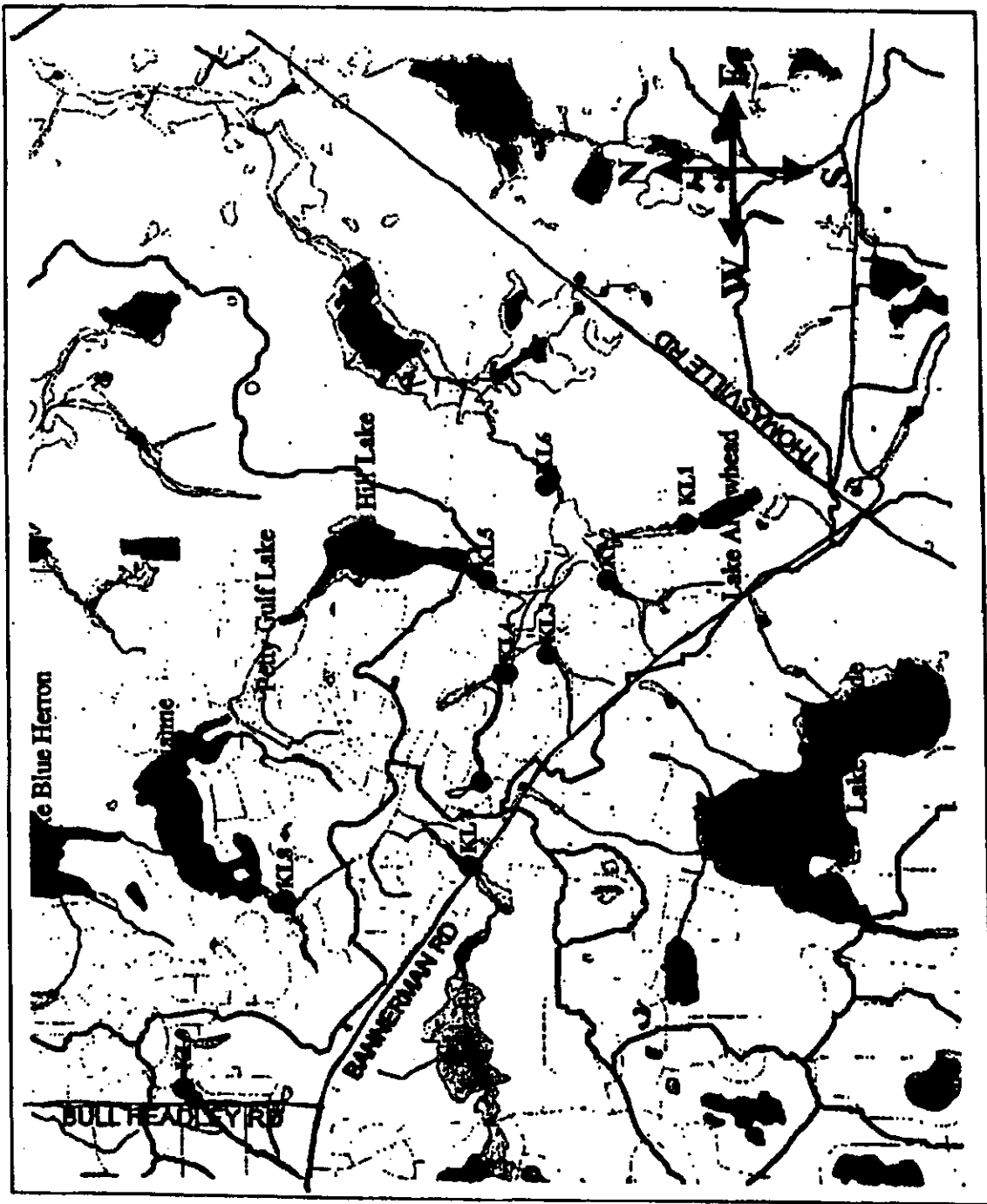


Figure 2: Sampling stations on creeks and ditches in drainage areas within the study area.

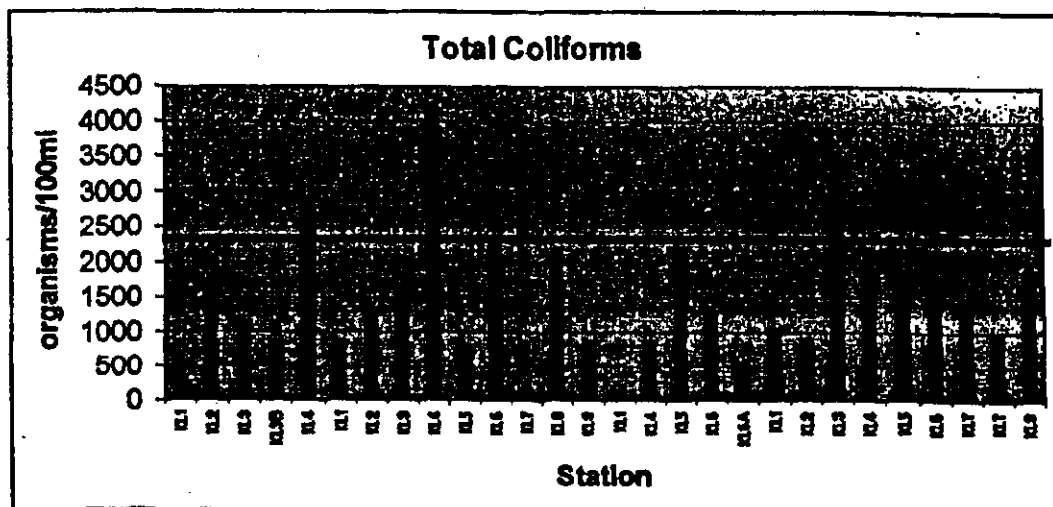


Figure 3: Total coliforms, 62-302.530 (7) may not exceed 2,400 organisms per 100ml for Class III recreational waters. This value was exceeded twice for station KL4 and once at station KL3.

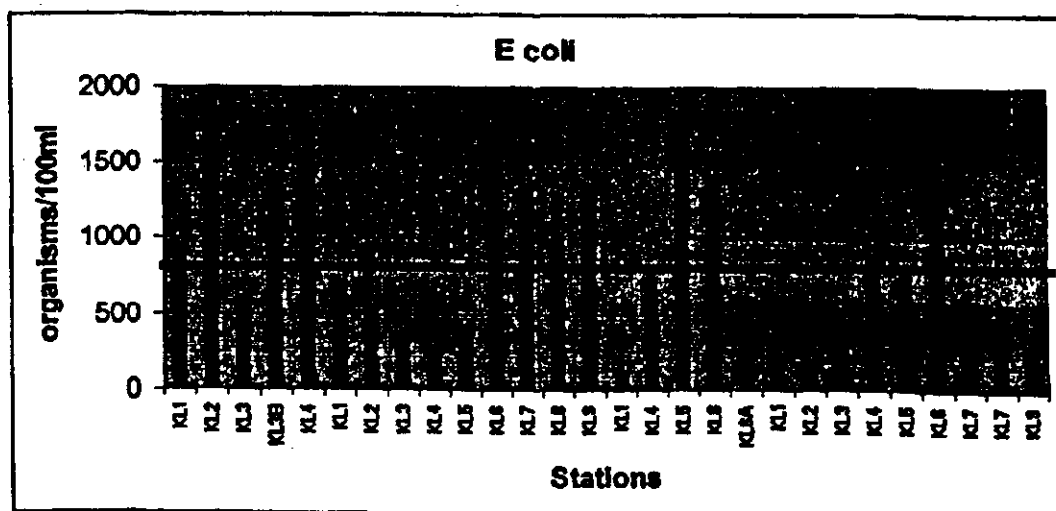


Figure 4: E. coli, 62-302.530 (6) may not exceed 800 organisms per 100ml for Class III recreational waters on any given day. This value was exceeded 12 times at various stations.



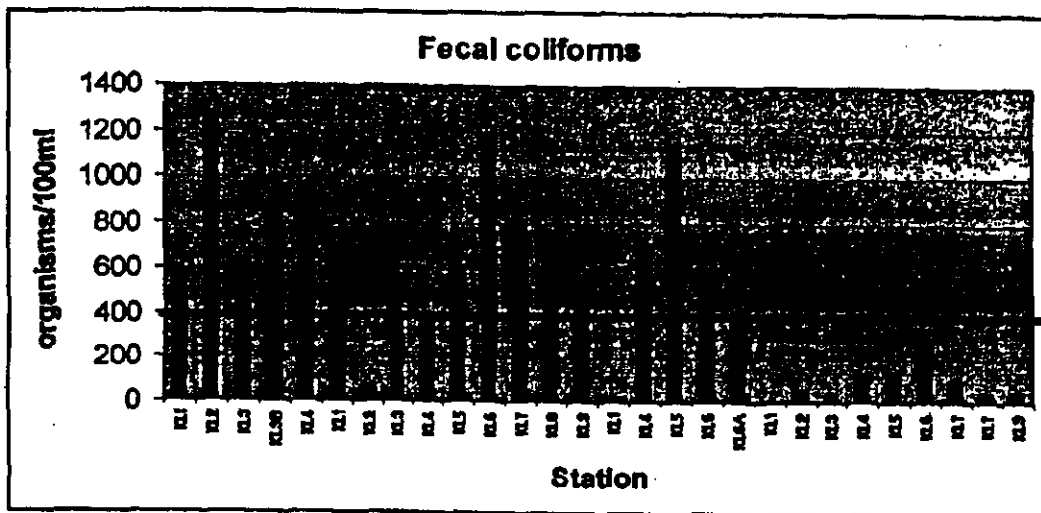


Figure 5: Fecal coliforms, 62-302.530 (6) may not exceed 400 organisms per 100ml for Class III recreational waters on any given day. This value was exceeded 15 times at various stations.

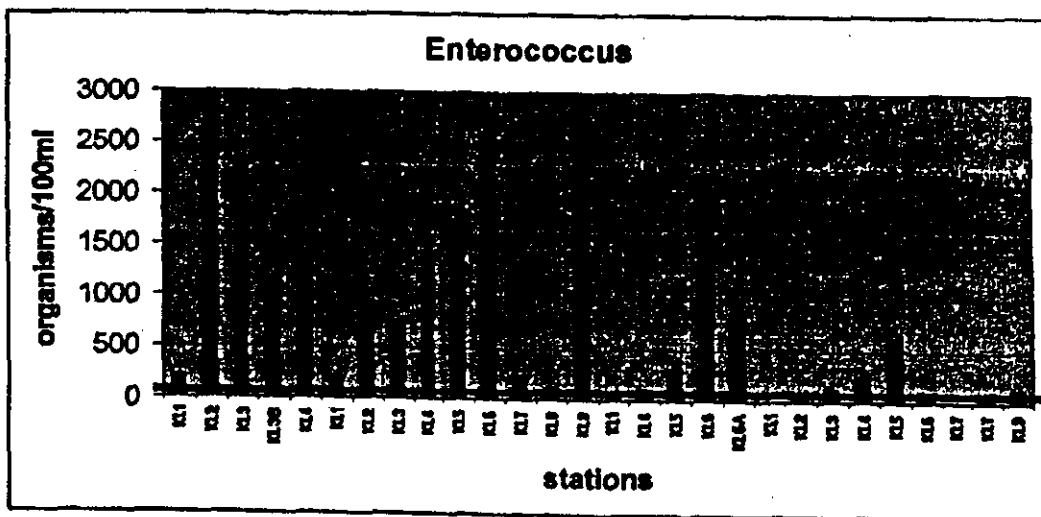


Figure 6: Enterococcus are a type of fecal coliform specific to humans. They may not exceed 104 organisms per 100ml for Class III recreational waters on any given day. This value was exceeded at most of the stations sampled in this study.

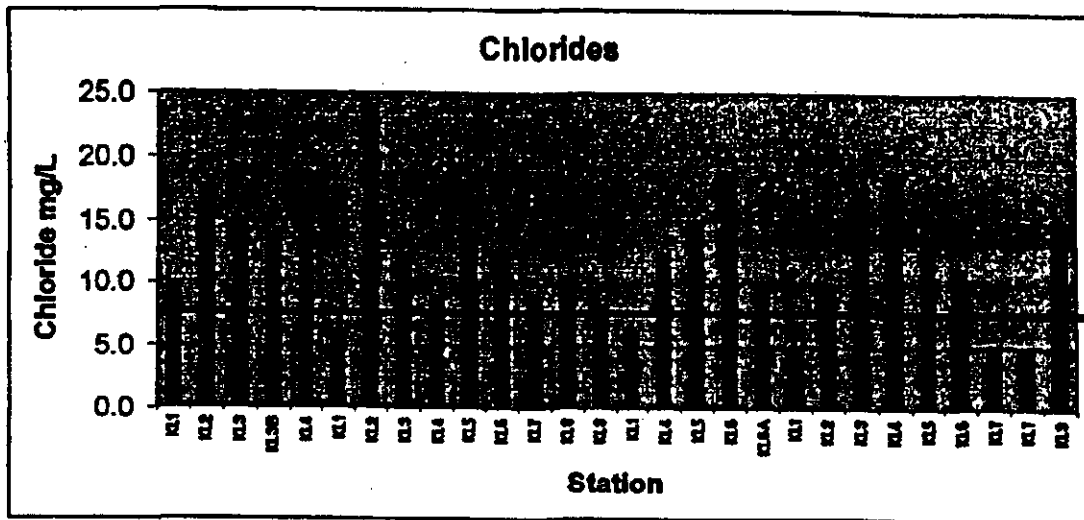


Figure 7: Chlorides are an indicator of human waste in areas distant from the coast. The background level of chlorides in our area is about 7 mg/L Chloride. 23 of the 28 stations sampled had elevated chloride concentrations also indicating enrichment of the surface waters.

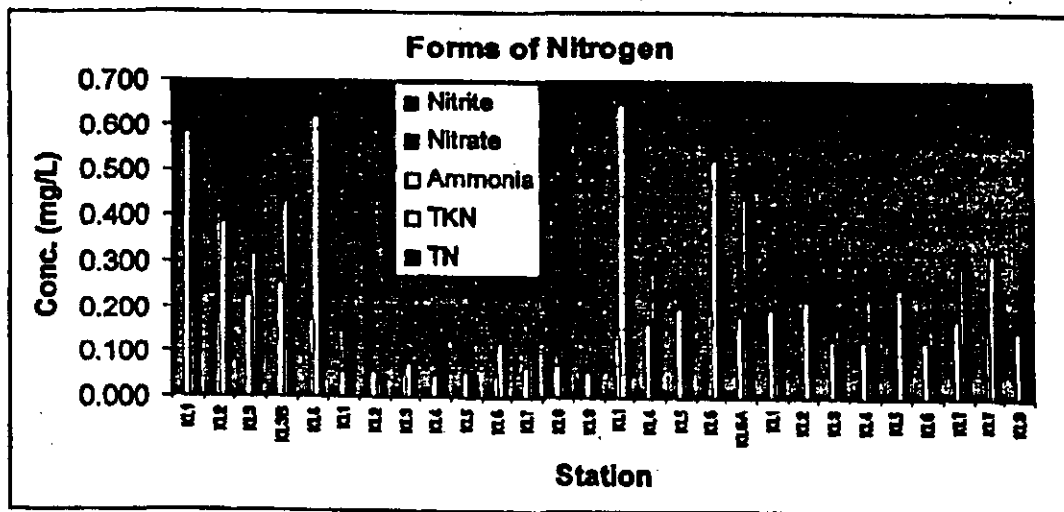


Figure 8: Reduced forms of nitrogen were prevalent in samples taken in the study area.

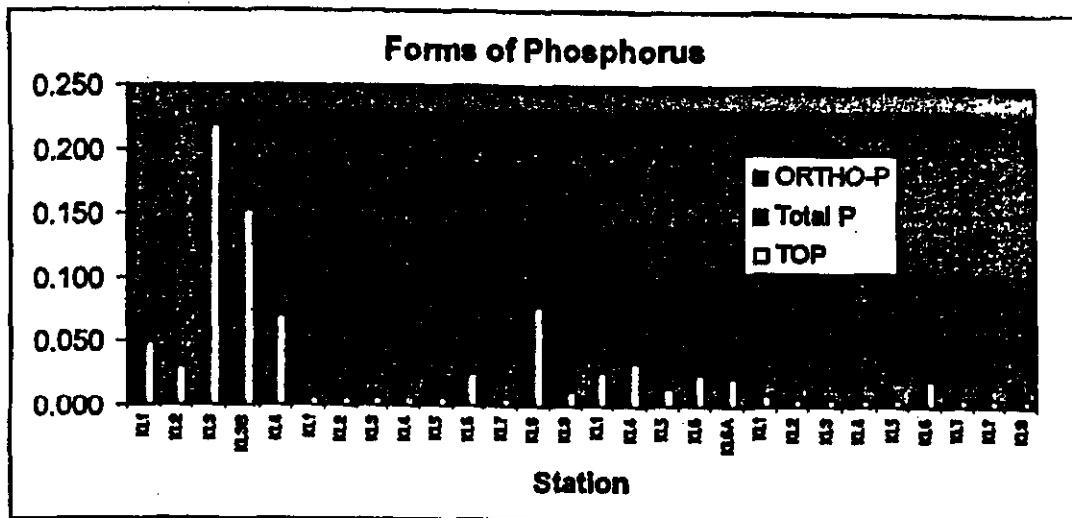


Figure 9: Organic phosphorus was prevalent in enriched samples also indicating possible effects of septic runoff.

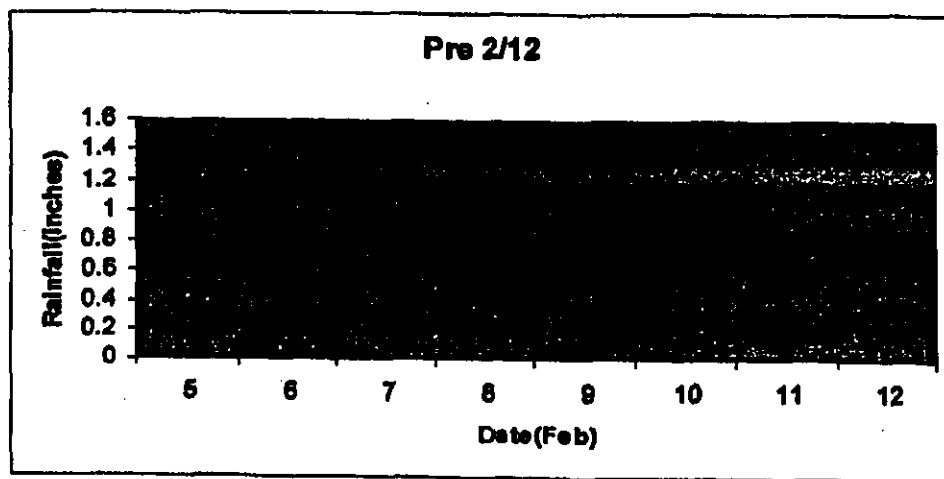


Figure 10: Rainfall for the 10 days prior to the 2/12/04 sampling.

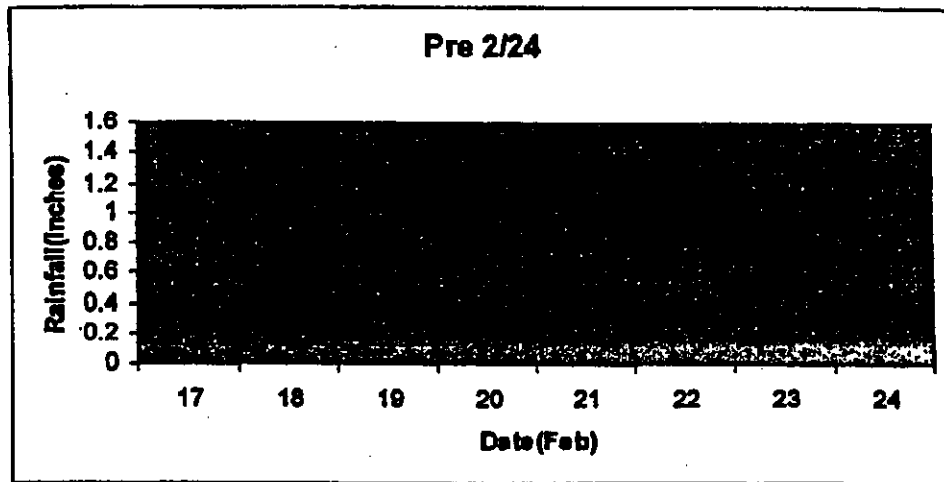


Figure 11: Rainfall for the 10 days prior to the 2/24/04 sampling.

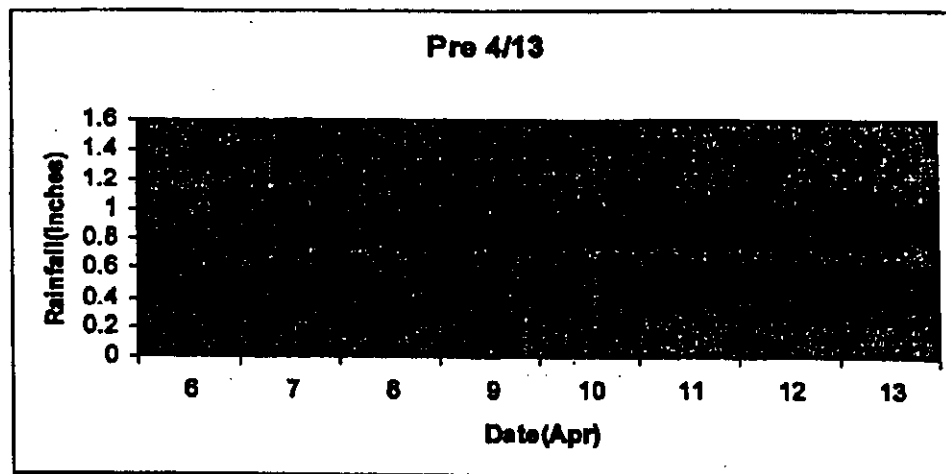


Figure 12: Rainfall for the 10 days prior to the 4/13/04 sampling.

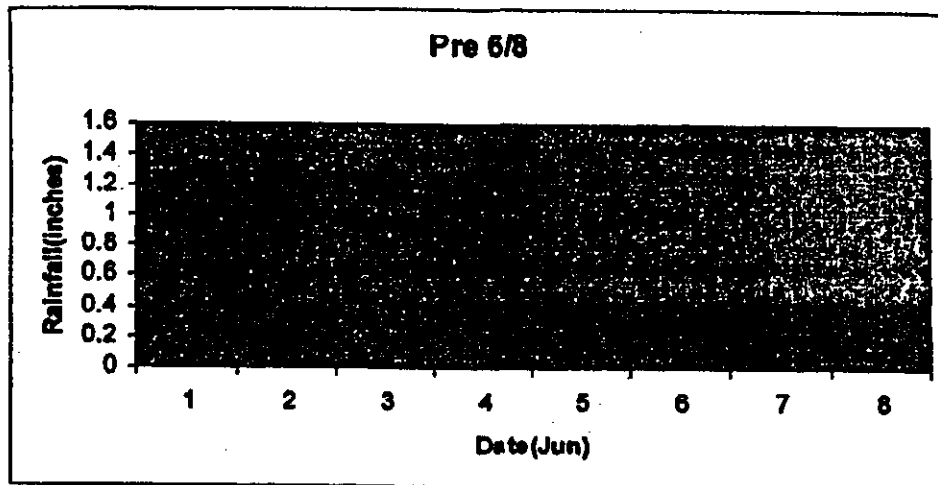


Figure 13: Rainfall for the 10 days prior to the 6/8/04 sampling.

**Summary:** Bacteria chlorides and nutrients were found at levels in the Lake Arrowhead drainage that are a cause for concern, both regarding loading to Lake Iamonia and human health. Elevated levels of Enterococcus indicate a human origin of these fecal coliform bacteria.

## **Appendix 1**

### **Florida Department of Health Microbiological Guidelines**

# Florida Department of Health Microbiological Guidelines

## Fecal Coliform Results Description

0-199 fecal coliform  
organisms per 100 ml of  
marine water

200-399 fecal coliform  
organisms per 100 ml of  
marine water

400 or greater fecal coliform  
organisms per 100 ml of  
marine water

## Enterococcus Results Description

0-34 *Enterococcus sp* per 100 ml  
of marine water

104 or greater *Enterococcus sp*  
per 100 ml of marine water

0-34 CFU/100 mL *Enterococcus*  
*sp* Geometric Mean

35-103 *Enterococcus sp* per 100  
ml of marine water

35 and Over CFU/100 mL  
*Enterococcus sp* Geometric Mean

\*A Poor rating requires resampling prior to issuing a Health Advisory or Warning. These indicate that contact with the water at this site may pose increased risk of infectious disease, particularly for susceptible individuals. A reading of NR means "No Result." This could indicate that no sample was taken at this point because of weather or other factors, or that an analysis result was not obtained from the laboratory.

## Florida Statutory Limits

\*Fecal Coliforms, 62-302.530 (6) Counts shall not exceed a monthly average of 200, nor exceed 400 in 10% of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period.

\*Total Coliforms, 62-302.530 (7). Counts shall not exceed a monthly average of 1000, nor exceed 1000 in 20% of the samples, nor exceed 2,400 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period.